Prevention Trumps Intervention

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The urgency for supporting student learning in mathematics often comes too late. Our need for intervention would be virtually eliminated if we could systematically provide the opportunity to learn, prevent misunderstanding, teach diagnostically, analyze errors, and offer immediate corrective feedback.

- *Provide the opportunity to learn.* Schools must deliver grade level content to each and every student. If students do not have the opportunity to learn grade level content, they will never demonstrate proficiency in an assessment of the standards.
- *Prevent misunderstandings.* This marks the difference between a good teacher and an expert teacher. The expert works with her professional learning community (PLC) to go beyond calendaring lessons to planning the lesson delivery. The expert relies on personal and PLC experience to know where students typically stumble and to design lessons to prevent those typical misunderstandings. The expert makes sure that the topic is sequenced properly and alerts students to problem areas.
- *Teach diagnostically.* The *Mathematics Framework for California Public Schools* states:

  > Most challenges to learning can be corrected with good diagnostic teaching that combines repetition of instruction, focus on the key skills and understandings, and practice. For some students modification of curriculum or instruction (or both) may be required to accommodate differences in communication modes, physical skills, or learning abilities. (p. 230)

  The diagnostic teacher asks deliberate questions, evaluates student responses, and moves the students forward during the interactions.
- *Analyze errors.* This work extends diagnostic teaching to the guided and independent practice times as well as assessment and homework sessions. Error analysis has to be paired with immediate, corrective feedback.
- *Give immediate, corrective feedback.* In the December issue of *Educational Leadership*, assessment expert Thomas Guskey reminds us that "35 years ago. . . [Benjamin] Bloom and his colleagues stressed that to improve student learning, . . . progress checks must provide feedback. . . and be followed up with correctives."

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Strategies That Work for Mathematics Intervention

The first step in supporting student learning is high quality instruction as a preventive measure; then intervention strategies can be applied. The strategies below are some of the strategies that I have found to be effective in classrooms are listed in alphabetical order, rather than order of importance. Teachers should not attempt to try *all* of them but should instead incorporate those that they feel would work best in their individual situations.

Answer Keys

Students solve problems, then check. Establish a routine and be adamant that students adhere to it. If a norm of integrity has been established in the student learning community, students will not copy the answers. One method is that students complete the assignment and take only that page to a correcting table where the teacher's edition or answer key and highlighters can be found. Students mark the incorrect answers with a highlighter,

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then rework those problems. The highlighting lets the teacher know how the student did on the first pass and the rework allows the student to persist in solving correctly. Another method is "Scrambled Answers" where students receive assigned problems and a sheet with answers scrambled. They first solve, then match their solutions.

Ballpark Answers
Students use their mental math, known operations, compatible numbers, visual images, and part-part-whole knowledge (see van de Walle, Ch 6) to "ballpark" the answers before finding solutions. I use the term "ballpark" to indicate a preference for sense-making over textbook-style estimation or rounding, which is too formulaic and often not useful. I have students write down the homework problems, then we ballpark all the solutions. Students use the ballpark estimates to judge the reasonableness of their calculated solutions.

Build, Draw, Write
Students model with concrete objects, record their work in a drawing, and then record the same work with numbers and symbols. Some people refer to this as concrete, representational, and abstract; but I have found that teachers and students more easily remember build, draw, write. Build, draw, write is not necessarily sequential. Draw doesn't literally mean draw. It might mean visualize, imagine, or rehearse, and uses the numbers, symbols, and notation of mathematics. If the writing is prose, it is about the how and why of the mathematics—not a step-by-step regurgitation of how to carry out a procedure.

Cues, Clues, and Crutches
Cues. Students are prompted to be wary of their own areas of vulnerability. My third grade student, Lewis, dove directly into subtraction problems. I asked what would make him remember to check for regrouping and he drew a small cartoon figure he called Rooster Man.

At first, I reminded Lewis to have Rooster Man help him remember to regroup. Eventually, he drew the character on his own and together they checked for regrouping. Eventually, Lewis did not need Rooster Man.

Clues. Students learn a rhyme, mnemonic device, or other learning support that helps them over a rough spot. For example, at the bottom of flashcards for adding six to a single digit number, a student might add the clue "five and one more."

Crutches. Students learn a coping strategy. For example, whenever my sixth grade student Ronisha got an assignment that required multiplication or division, she had to turn her paper over and make her own multiplication table for 3 through 8 times 6, 7, 8. Since she had not committed those facts to memory, I preferred to hold her responsible for the grade level learning rather than spending a generous portion of time remediating her fact knowledge.

Danger Zone Alerts
When delivering instruction on the topic, alert students to areas that are commonly misunderstood. For example, when teaching decimal place value, alert students that decimal place value and whole number place value are very specific. For instance, 0.12 might be mistaken as greater then 0.3. Demonstrate, using base ten models, that 0.12 has a single tenth and two hundredths whereas 0.3 has 3 tenths pieces.

Double Points
Students receive one point for the correct answer and one point (or more) for the correct solution. This places grading emphasis on the solving rather than the answering.

Focus Friday
On Fridays, students meet in a group that is focused on their specific learning need. For example, a team of three teachers who are currently teaching multi-digit division might organize a group to review 6, 7, 8, and 9 facts; one group for review of procedure; and a challenge group. The majority of students in each teacher's classroom would complete an independent assignment. Each teacher would work with the small focus group made up of students from all three classrooms. Groups could meet weekly, every other week, or once per month. This can also be done across grades when there are overlapping learning needs.

Hot Spot Assignments
Student assignments are specific to areas of difficulty that arise when teachers monitor independent practice, analyze homework, and ask questions. In this strategy, teachers make note of the specific areas of need, and then generate work that untangles the difficulty.

For example, simplifying fraction solutions might be overlooked. I recommend giving a page of fractions and asking students to identify whether they could be simplified. Then, as fraction operation assignments are completed, ask students to review solutions to verify that all fractions have been simplified.

Immediate Feedback
Students get an immediate response as they work each problem. Feedback could be provided by the teacher or a learning partner.

My Mistake
Students earn back credit for incorrect homework problems by analyzing and noting their own mistakes ("I added incorrectly," or "I multiplied instead of divided"). Reworking the problem earns back points or fractions of points.

Nontraditional Computation Methods
Students learn methods other than the standard United States computation methods, for example, partial products for multi-digit multiplication or compensation methods for addition and subtraction.

Preview
All students can benefit from participating in a preview of the lesson. For struggling students, this can take place during a before-school session, in a small group a day ahead of the whole-class lesson, or in support classes. This front-loading allows struggling students to then participate in the whole-class instruction.

Repeat, Review, Reteach, Remediate
Students require various levels of intervention support and these typical intervention strategies. *Repeat* works best when the student has a grasp of the topic, but might be unclear on certain areas. *Review* suits students who do not need a full repeat. They do not need a different approach; they just need a review of portions of the lesson. *Reteach* is for students who need a different approach. For example, if the teacher presented the topic abstractly, build and draw might help the student. *Remediate* is for students needing prerequisite skills. Their missing skills prevent them from succeeding in the current topic and there are no cues, clues, or crutches to provide adequate support.

Response Cards or Boards
Students individually respond to a question or prompt by using a white board, scratch paper, voting device, or response card. The teacher scans all responses, providing scaffolding, cues, or questions where necessary. The teacher gives specific feedback and provides immediate correctives as appropriate. You might also use a preprinted card. For example, an index card with the letters A, B, C, or D written on each edge would allow students to respond to multiple choice questions. It is critical for every student to respond and for scaffolding, correctives, and feedback to be offered.

Right-sized Problems
Students receive problems selected for their current level of understanding plus a little push. Struggling students get less complex problems and gifted students or fast finishers get more complex problems. For example, when subtracting fractions, struggling students might get problems with simple denominators or easily computed common denominators or fewer problems needing simplified solutions. Gifted students would get mixed numbers with difficult to compute common denominators and solutions requiring simplifying.

Sequenced Problems
Students receive specially designed problems that progress from easy to hard in order to facilitate error analysis. For example, multi-digit multiplication problems can progress from no regrouping needed to multiples of tens to regrouping in one place with easy facts to regrouping with more than one place with easy facts to regrouping in one place with hard facts, and so on.

Solve, Match, and Challenge
Students are partnered. They solve two or three problems independently and then compare solutions. If solutions do not match, students challenge the response of the other and rework together until they both know how to solve for the correct solution.

Strategy Instruction
Students receive instruction in strategies that support computation. John van de Walle's *Elementary and Middle School Mathematics* offers a wealth of strategies. Addition ex-

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amples include making a ten, doubles, and near doubles. Multiplication examples are doubles, squares, and times five plus one more set or times ten less one set.

Technology Assistance
There are a multitude of computer software programs, applets, virtual courses, and web sites that claim to support students. My personal opinion is that it is rare to find a technology solution that adequately supports a struggling student. I have had more success having proficient and advanced students utilize technology while I work with the struggling students. I have used Excel and Schoolhouse Technologies to generate hot spot assignments. Multiflyer allows students to work on their facts-to-learn and occasionally refresh their facts-I-know. This site can be found at **gdbdp.com/multiflyer/play_online. html**. The National Council of Teachers of Mathematics' Illuminations web site **illuminations.nctm.org/ActivitySearch.aspx** includes many useful applets as does the National Library of Virtual Manipulatives at **nlvm.usu.edu/en/nav/vlibrary.html**. I have worked with schools that use Get Ahead Math, Accelerated Math, and publisher intervention sites, but all must be monitored in order to get the best effect for student learning. Math Forum has a searchable site called Math Tools at **mathforum.org/mathtools/**.

Textbook
Once, when providing a model lesson in a fourth grade classroom, I made a study guide for the geometry chapter. Not a single student in the class knew how to use the textbook to find information or learning supports. Students must use textbooks to support their learning. They need to learn the features of their text that support learning: the examples, glossary, index, and review pages. Textbooks are sent home as learning support tools and parents should familiarize themselves with the text. Many teachers also have alternate textbooks on hand for reteaching purposes.

Tune-Ups
Students receive four to ten problems in addition to the current homework. The tune-ups address specific areas of need. During the time of the year I call "division season" I usually recommend that teachers cease devoting full lesson sessions to practice division and instead add three to four division problems to all homework assignments for the next two or three weeks.

Warm-Ups
Students solve warm-up problems specifically selected to clarify areas of misunderstanding. Use this method when you do not have the time or the need to dedicate a full lesson to clarification. Warm-ups can be used in conjunction with preview or review to its best effect.

Workstations and Games
Students are provided with memorable experiences where they explore mathematical ideas, connect to prior learning, and engage in practice. I have seen Marilyn Burns' *About Teaching Mathematics,* Kathy Richardson's *Developing Math Concepts,* Patsy Kanter's *Partner Games*, and Frog Publications' *Learning Games* all used to improve learning. I often recommend that teachers place repeatable activities in the workstation area. For example, give students three index cards. Have them write the decimal form on one card, fraction form on another, and a shaded decimal grid or fraction square on the third card. Once students ensure that the three representations are correct, the cards can be used at a workstation for a matching or concentration game.

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